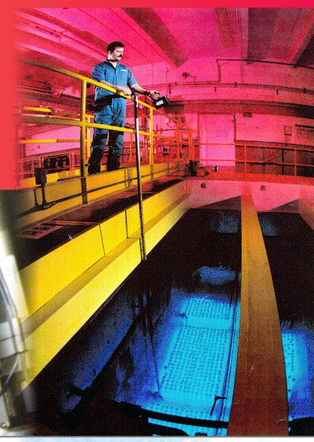
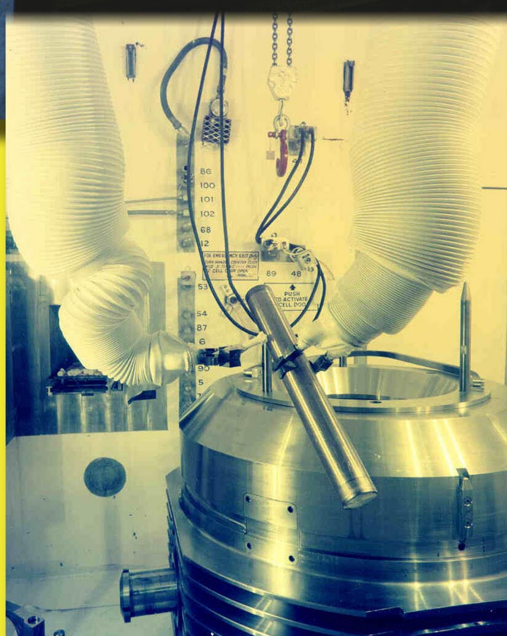
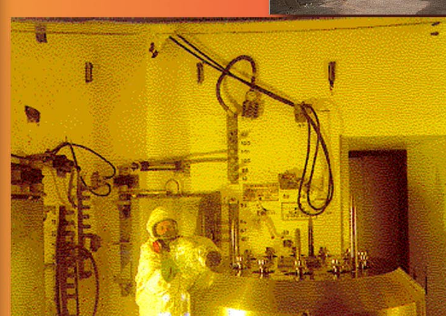
Nonactinide Isotopes and Sealed Sources Management Group

Fiscal Year 2000 Annual Report



Complexwide Resources Solving Site Specific Problems





U.S. Department of Energy

January 2001

The Nonactinide Isotopes and Sealed Sources Management Group (NISSMG) provides experienced technical personnel who implement innovative solutions using complexwide resources for site specific issues.

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Nonactinide Isotopes and Sealed Sources Management Group Fiscal Year 2000 Annual Report

U.S. Department of Energy

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CONTENTS

FIGURES

ACRONYMS

ATR	Advanced Test Reactor
C of C	Certificate of Compliance
DOD	Department of Defense
DOE	Department of Energy
DOE/AL	Department of Energy/Albuquerque Operations Office
DOT	Department of Transportation
DP	Office of Defense Programs
DU	depleted uranium
EM	Environmental Management
ETTP	East Tennessee Technology Park
FEMP	Fernald Environmental Management Project
FY	fiscal year
GTCC	Greater-Than-Class-C
HEU	high-enriched uranium
HFIR	High Flux Isotope Reactor
HI	heavy isotopes
INEEL	Idaho National Engineering and Environmental Laboratory
INMMP	Integrated Nuclear Materials Management Plan
IPABS	Integrated Planning, Accountability, and Budgeting System
LANL	Los Alamos National Laboratory
LEU	low-enriched uranium
LLW	low level radioactive waste
MD	Office of Fissile Materials Disposition
MEMP	Miamisburg Environmental Management Project
MLLW	mixed hazardous and low level radioactive waste
MMP	Material Management Plan
MOU	Memorandum of Understanding
NE	Office of Nuclear Energy
NEPA	National Environmental Policy Act
NISS	nonactinide isotopes and sealed sources
NISSMG	Nonactinide Isotopes and Sealed Sources Management Group

NM	nuclear materials
NMFA	Nuclear Materials Focus Area
NMI	Nuclear Material Integration
NMMG	Nuclear Materials Management Groups
NMMSS	Nuclear Materials Management and Safeguards System
NMSP	Nuclear Material Stewardship Program
NN	Office of Nonproliferation and National Security
NORM	Normally Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NU	natural uranium
OR	Oak Ridge
ORNL	Oak Ridge National Laboratory
OSRP	Offsite Source Recovery Project
PL	Public Law
PNNL	Pacific Northwest National Laboratory
RCT	Radiation Control Technician
RFETS	Rocky Flats Environmental Technology Site
RFFO	Rocky Flats Field Office
RSS	radioactive sealed source
RTG	radioactive thermoelectric generator
SNAP	Systems for Nuclear Auxiliary Power
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SNM	special nuclear material
SRS	Savannah River Site
TBD	to be determined
TRU	transuranic
WAC	waste acceptance criteria
WESF	Waste Encapsulation and Storage Facility
WIPP	Waste Isolation Pilot Plant

1. VISION AND MISSION

The Nonactinide Isotopes and Sealed Sources Management Group (NISSMG) is managed by the Department of Energy (DOE) Albuquerque Operations Office (DOE/AL). The NISSMG is one of five nuclear materials management groups (Plutonium, Uranium, Heavy Isotopes and Spent Nuclear Fuel are the others) created by the Deputy Assistant Secretary for the Office of Environmental Management's (EM's) Office of Integration and Disposition (EM-20) to ensure nuclear material integration across the DOE nuclear materials complex.

NISSMG Team

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The NISSMG was formed as a logical extension of EM's Nuclear Material Stewardship program, their Nuclear Material Integration (NMI) program, and recommendations from the action agenda listed in the Nuclear Materials Council report, "A Strategic Approach to Integrating the Long-Term Management of Nuclear Materials, The Department of Energy's Integrated Nuclear Materials Management Plan" (INMMP).[b]

The NISSMG provides an integrated, corporate structure for achieving EM missions through effective and integrated cradle-to-grave management of nonactinide isotopes and sealed sources (NISS) materials in a way that provides corporate management and coordination, provides cost savings and budgetary efficiencies, promotes continued risk reduction, advances integrated management of nuclear materials, and results in improved effectiveness.

This group is managed as a virtual organization, drawing resources from DOE, and its laboratories and sites, to manage certain technical activities. Although there is a small number of permanent staff to manage certain activities and the day-to-day operations of the group, most of the resources are devoted to technical specialists distributed around the complex. These technical specialists serve as resources to sites that lack specific expertise in managing or disposing of sealed sources, standards, other nuclear research materials, and low atomic number materials.

b. Nuclear Materials Council, "A Strategic Approach to Integrating the Long-Term Management of Nuclear Materials, The Department of Energy's Integrated Nuclear Materials Management Plan," June 2000.

The NISSMG coordinates its EM material management activities with other DOE programmatic organizations with a focus on the needs of user organizations located at eight operations offices and two field offices that form the DOE nuclear complex, including the Office of Fissile Material Disposition, the Office of Defense Programs, the Office of Nuclear Energy, the Office of Nonproliferation and National Security, and the Office of Civilian Radioactive Waste.

The program coordinates a complexwide program providing consistent use, reuse, recycle, and disposal options to sites with excess NISS materials. The program leads a concerted effort to use the existing infrastructure to resolve materials issues and dispose of NISS materials. The NISSMG supports EM's technology research and development efforts by implementing developed technologies at multiple sites, and by optimizing technology investments.

"Preservation and proper management of these invaluable and irreplaceable nuclear materials can and will continue to provide great benefit not only to the DOE complex but to the nation as a whole."

Glenn T. Seaborg - 1951 Nobel Peace Prize Winner in Chemistry

The NISSMG activities concerning materials with no path to disposition (orphans) provided input to departmentwide advance planning by identifying processing needs and potential utilization opportunities of multipurpose treatment technologies in future DOE facilities.

The program is site orientated in terms of focusing its activities on user organizations and site-specific needs. It is directed at providing immediate support for site closure actions, complex-wide disposition, and technical assistance for nuclear material disposition planning.

2. CHARTER

The INMMP, required by Section 3172 of the fiscal year (FY) 2000 National Defense Authorization Act, committed DOE to evaluate establishing Nuclear Materials Management Groups (NMMG) to manage nuclear materials as part of its multiyear agenda.

As a pilot, five NMMGs were formed: plutonium (Pu), uranium (U), heavy isotopes (HI), NISS, and spent nuclear fuel (SNF). EM and the responsible field entities are developing charters for each specific group. The NMMG for NISS (the NISSMG) is sponsored by the DOE EM and managed by the Albuquerque Operations Office to serve as a complexwide resource for the management of DOE-owned NISS materials.

3. SCOPE

In general, the materials managed by the NISSMG are excess materials other than plutonium, uranium, and spent nuclear fuel. These materials include a wide spectrum of radionuclides, including nonactinide elements with an atomic number less than 90. All radioactive isotopes of elements with atomic numbers less than 90 are within the scope of the NISSMG regardless of form. Other manmade isotopes in the form of sealed sources, standards, and research materials, and special categories, such as radioactive thermoelectric generators (RTGs), pacemakers, neutron sources, and a spectrum of orphan isotopes and activated materials at small sites (such as Fernald) are also within the scope of the NISSMG. The NISSMG is helping sites manage and disposition all NISS nuclear materials owned by EM with a significant integration role in the management and disposition of NISS materials owned by other DOE programs. The NISSMG also has a role in assisting with the management and disposition of excess DOE loaned or leased materials at universities and in industry.

4. INTERFACES

The NISSMG interfaces with a number of organizations. In addition, other interfaces are the Nuclear Materials Focus Area (NMFA) and the Offsite Source Recovery Project (OSRP).

4.1 Nuclear Material Stewardship Program

On January 20, 1998, DOE-EM chartered the Nuclear Material Integration Project (NMI) to identify EM's nuclear material inventories and determine disposition paths for excess nuclear materials. NMI created three material evaluation teams to undertake this project and to prepare material-specific management plans. The NISS team, one of the three teams, was assigned responsibility to evaluate all radioactive isotopes with an atomic number less than 90, and all sources, samples, and standards, irrespective of atomic number. This team reported its findings in the "Material Management Plan for Nonactinide Isotope and Sealed Sources."[c] The NISSMG was formed as the logical extension of EM's Nuclear Material Stewardship program and their NMI program.

c. NISS Team, "Materials Management Plan for Nonactinide Isotopes and Sealed Sources (NISS)," Draft Rev. 0, December 4, 1998.

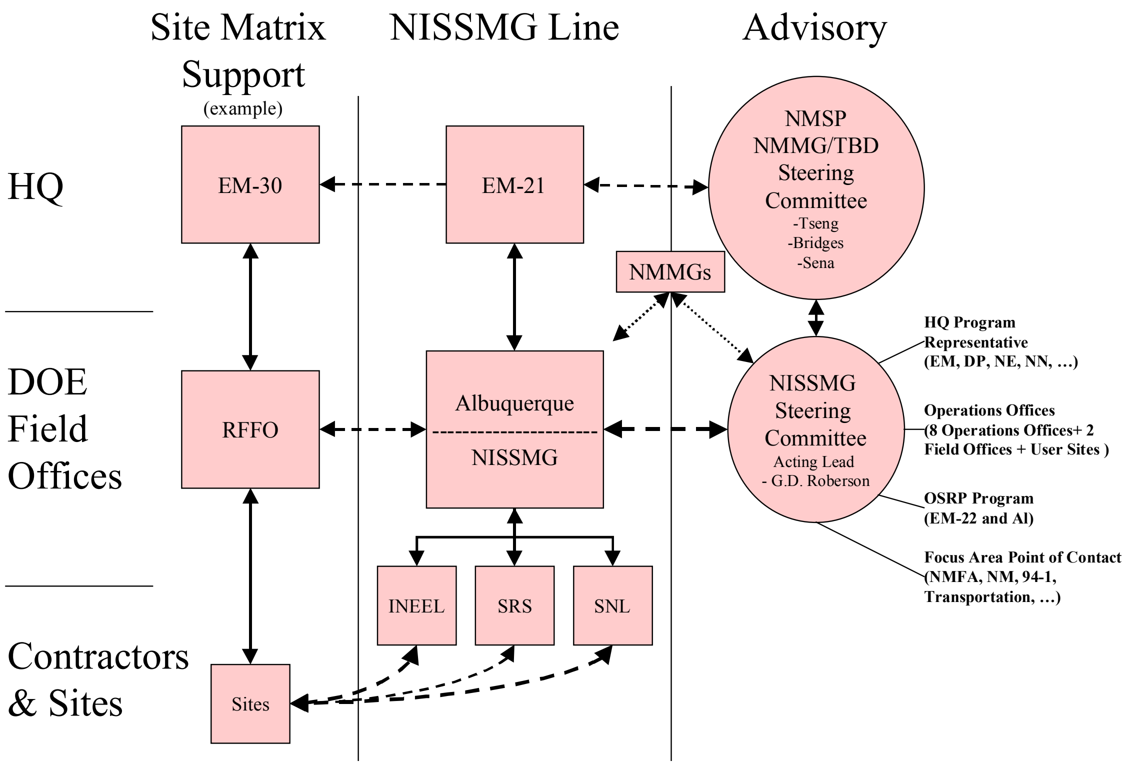

Figure 1. NISSMG interfaces.

4.2 Nuclear Materials Focus Area

The Nuclear Materials Focus Area (NMFA) conducts a research and development program to develop technologies to support the safe management and expeditious stabilization of nuclear materials currently under the purview of EM. The NMFA identifies and provides technical solutions to the broad range of challenges associated with the management of nuclear materials. The NMFA also aids sites in managing the inventory of nuclear materials "owned" by EM, including nuclear materials "owned" by other DOE programs, but stored in EM facilities or sites, except for nuclear weapons components and materials not yet transferred to EM. The specific materials scope of the NMFA includes:

- Transuranic isotopes [all forms of plutonium (Pu), neptunium (Np), californium (Cf), curium (Cm), americium (Am), mixed oxides, and residues]
- Uranium and thorium [all forms of uranium-233 (U-233), depleted uranium (DU), thorium (Th), natural uranium (NU), high-enriched uranium (HEU), and low-enriched uranium (LEU)]

- Isotope materials and sealed sources [material such as chromium (Cr), cobalt (Co), protactinium (Pa), actinium (Ac), strontium (Sr), and cesium (Cs) standards; and sources such as Cs, plutonium–beryllium (Pu-Be), americium–beryllium (Am-Be), radon (Ra), and Co]
- All material contained in the Defense Nuclear Facilities Safety Board recommendations 94-1 and 97-1.

The NMFA coordinates its research activities with those of other DOE organizations including the Office of Fissile Materials Disposition (MD), the Office of Defense Programs (DP), the Office of Nuclear Energy (NE), and the Office of Nonproliferation and National Security (NN).

4.3 Offsite Source Recovery Project

The Offsite Source Recovery Project's (OSRP) purpose is to fulfill DOE's Public Law (PL) 99-240 responsibilities. The OSRP addresses approximately 18,000 obsolete, excess, or abandoned radioactive sealed sources (RSSs), with emphasis on commercially owned RSSs. However, some DOE and Department of Defense (DOD) owned RSSs will also be recovered.

DOE/EM SEALED SOURCE PROGRAMS

OSRP ($3.2M)	NISSMG ($0.3M)
• Non-DOE Neutron Sources	• DOE Sealed Sources
• NRC GTCC Sources	• Orphan Materials (atomic no. less than 90)
• Implement Low Level Radioactive Waste Policy Amendments Act of 1985	• Focus on Reuse/Recycle
• Protect Public Safety	• Support Paths to Closure
• Storage/Disposal Operation	• Technical Support to Sites

Integration – Coordination Activities

NISSMG – serve as reuse/recycle assessment for OSRP.
OSRP – provide interim storage and disposal for DOE "GTCC" a case-by-case basis.

Figure 2. DOE/EM sealed source programs.

Similar radioactive materials may also be recovered at the Nuclear Regulatory Commission's (NRC's) request, in accordance with a June 18, 1999, Memorandum of Understanding between the DOE and NRC. However, the priority is to recover the highest risk RSS materials and place them into a DOE-controlled safe environment.

The OSRP scope includes all activities necessary to reduce public health and safety risks associated with RSSs and other greater-than-class-C (GTCC) waste, pursuant to responsibilities defined in DOE PL 99-240. Major activity categories include: (1) planning and management, (2) recovering unwanted RSSs based on health and safety risk priority, (3) developing and implementing shortand long-term storage, (4) recycling and reusing materials whenever appropriate, (5) developing disposal capacity for RSSs and other GTCC waste, and (6) removing other high risk GTCC waste.

Most of the sealed sources included in the OSRP contain special nuclear material. The project's planning emphasizes the requirement associated with managing this type of radioactive material. Another type of sealed source is the radioisotope thermoelectric generator (RTG) containing Sr-90.

DOE's responsibility under PL 99-240 includes developing disposal capacity for all GTCC waste. However, the OSRP project scope is currently limited to developing RSS disposal options. Developing national GTCC waste disposal capacity for commercial nuclear power plant decommissioning projects is a larger issue and not currently a part of the OSRP scope.

5. CLOSURE SITE SUPPORT IN FY 2000

The NISSMG is focusing its initial attention on providing immediate support to site closure actions. This represents DOE's prioritization of potential projects against its limited resources. The Miamisburg Environmental Management Project Mound Facility (MEMP) located near Miamisburg, Ohio, commonly referred to as the Mound Plant, is one of the earliest closure sites. Other early closure sites that NISSMG is aiding are the Fernald Environmental Management Project (FEMP), which is a former uranium processing facility undergoing environmental remediation located about 18 miles northwest of Cincinnati, Ohio; and the Rocky Flats Environmental Technology Site (RFETS) located about 15 miles northwest of Denver, Colorado.

Figure 3. Arial photograph of Mound Plant today.

5.1 Mound Plant

The best example of how NISSMG supports closure sites is shown by the activities at the Mound Plant. To meet the aggressive schedule to close the Mound Plant, the NMI NISS Team began work in April 1998 with the DOE Ohio Field

Office and the Mound Plant to disposition the Mound Plant's nuclear materials. The NISS team helped complete the Mound Plant's material disposition planning effort, which led to successful disposal of the high-enriched uranium (HEU) from the Mound Plant's Californium reactor in August 1998. Since that time, the business relationship has become a partnership between the Mound Plant and the NISSMG, who were both industrious and innovative in successfully disposing of all excess nuclear material at the Mound Plant by the end of FY 2000. Their accomplishments are described as follows.

1. The Mound Plant program baseline included disposal of the ionium as low level radioactive waste (LLW). This was problematic due to the high activity of the protactinium-231 (Pa-231) as a waste form, and the high cost of characterization to meet the requirements of the Nevada Test Site (NTS) waste acceptance criteria. NISSMG analysis determined that Pa-231 is one of the unique and special isotopes in the DOE complex. The NISSMG leveraged the existing assets at the Oak Ridge National Laboratory's (ORNL's) Chemical and Analytical Sciences Division to receive the ionium, then separate and purify the Pa-231 for beneficial use. The residual material could only be disposal of as LLW after the Pa-231 was separated. [Pa-231 is produced by neutron capture on thorium-230 (Th-230), or can be separated from long-decayed enriched uranium-235 (U-235).] Since DOE is no longer producing Pa-231, the Mound Plant's stockpile of Pa-231 was virtually all that remained. The Pa-231 stockpile will allow scientists to perform fundamental research on the physics of protactinium solids and vapor state chemistry of protactinium-based compounds. This process not only disposed of an excess nuclear material, but also provides a valuable isotope (Pa-231)

Figure 4. Loading of irradiated ionium materials at the Mound Plant.

for use in meeting DOE’s nuclear material stewardship responsibility of providing national resource materials.

Ionium shipped to ORNL on June 13, 2000. Cost savings are estimated at $200,000.

2. Due to the closure activities, the Mound Plant has very limited material characterization capability remaining. Not only did the NISSMG facilitate a meeting with a private sector company that could provide mobile characterization capability, the private sector company provided as a demonstration (at no cost to DOE) the waste profile for the cadmium moderator blades from the Californium reactor. This demonstration met Envirocare’s waste acceptance criteria (WAC) that, in turn, enabled the Mound Plant to dispose of the cadmium moderator blades.

   Cadmium moderator blades shipped to Envirocare in October 1999. Cost savings are estimated at $20,000.

Figure 5. Forklift loading cobalt-60 source in the shipping container for shipment to the Nevada Test Site for disposal as LLW.

3. The Mound Plant had several neutron sources that were very problematic because of the activity level and the chemical composition [plutonium-238 (Pu-238)/ fluoride (F) and Pu-238/ oxygen-18 (O-18)]. Los Alamos National Laboratory (LANL) was unable to support their disposition, making these sources orphans. The NISSMG developed a strategy where Pu-238 will be separated from the light elements and recycled for research and development efforts at ORNL to support the Office of Nuclear Energy (NE-50) activities in the Space Program.

4. The Mound Plant had a significant amount of curium-243 (Cm-243) with no path for disposal. NISSMG identified options to reuse this material at ORNL that enabled the Mound Plant to ship the material off site for use in other DOE programs.

5. The Mound Plant program baseline included disposal of one kilogram of thorium as LLW, in agreement with the general recommendations contained in the Material Management Plan for thorium (Th).[d] NISSMG identifed a use for the thorium at the Thorium Laboratory at ORNL; consequently, the thorium material was shipped to ORNL, thereby saving the relativily high cost of characterizing and disposing of this material.

   Thorium shipped to ORNL in June 2000. Estimated cost saving are $20,000.

6. There were several uranium-233 (U-233) sources left from the Mound Plant's former weapons mission activities. The NISSMG's evaluation revealed that U-233 sources are being manufactured at the Thorium Lab at the East Tennessee Technology Park (ETTP) at Oak Ridge (OR). In integrating the excess U-233 sources into the inventory at OR, the Mound Plant was able to ship this material off site and these sources are being reused within the DOE nuclear materials complex.

   U-233 sources shipped to ETTP on March 1, 2000. Cost savings estimated at $10,000.

7. A commercial sealed-source vendor wanted $480,000 to dispose of a large cobalt-60 (Co-60) 600-curie (Ci) source from the Mound Plant as LLW. The Mound Plant and NISSMG determined this was not cost effective and established an alternate disposal path using the NTS as LLW.

   Cobalt source shipped to the NTS in July 2000. Cost savings are estimated at $400,000.

8. The Mound Plant had over 200 grams of orphan plutonium-239 oxide (239PuO2) containing 0.8% Pu-238 and 12% Pu-240 (by weight). The Savannah River Site (SRS) had agreed to take the material, but transportation issues relative to hydrogen gas generation had to be resolved before it could be shipped. The NISSMG conducted a gas

Figure 6. Monitoring for oxygen depletion while inerting the 2R with argon, and FedEx with Pu-239 leaving Mound Plant.

d. Uranium/Thorium Team, Nuclear Materials Integration Project, "Material Management Plan for Thorium," Final Draft, November 1998.

generation analysis and evaluated Department of Transportation (DOT) and DOE shipping requirements.

The characterization of hydrogen gas generation for the Mound Plant's Pu-239 had to be conducted with available historical process knowledge and current radiography, since not even a glove box was available at the Mound Plant to support limited repackaging of the existing containers.

A method was developed to analyze the pressure buildup and hydrogen concentration within the shipping container. The NISSMG team used bounding calculations with several levels of conservatism for the gas generation, since the history, condition, and moisture of the PuO2 could not be known to ideal precision. The NISSMG team applied existing theoretical modeling with available experimental data to a real-world application with limited data, time, and facilities. The NISSMG team developed a technical basis and promoted coordination between the DOE sites that allowed for shipment of these materials on October 9, 2000, meeting a site closure milestone.

Pu-239 oxide shipped to the SRS on October 9, 2000. Cost savings estimated at $50,000.

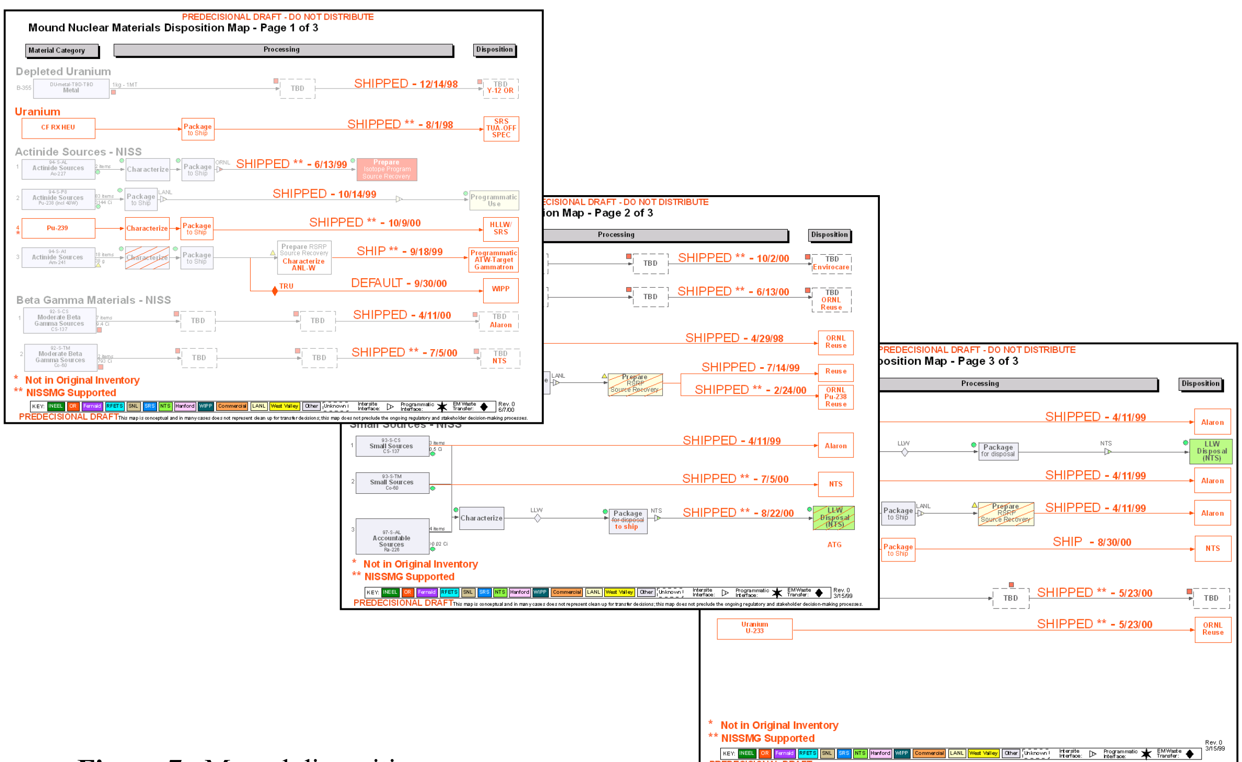

Figure 7. Mound disposition maps.

9. The Mound Plant program baseline included shipping 38 grams of americium-241 (Am-241) to LANL for disposal. NISSMG explored commercial sale for reuse as feed material for neutron sources. However, the Mound Plant was unable to characterize this material in sufficient detail for this option. After consulting with NISSMG, the Am-241 was transferred to the Mound Plant transuranic (TRU) waste program for disposal.

   Am-241 transferred to the Mound Plant TRU program in September 2000. Cost savings are estimated at $400,000.

The end result of the NISSMG support activities at the Mound Plant is that all the nuclear material has been dispositioned, thus reducing the mortgage costs in security, safeguards, and technical support.

5.2 Fernald Site

In June 2000, the Ohio Field Office requested NISSMG support to develop a suite of disposition baseline alternatives for the FEMP Site NISS materials. These alternatives are documented in the *Fernald Sealed Source Disposal Plan*[e] submitted to FEMP on September 28, 2000. The plan included disposal alternatives and cost estimates for characterizing, treating, shipping, and disposing of the sources as needed. The Fernald Area Office accepted the plan.

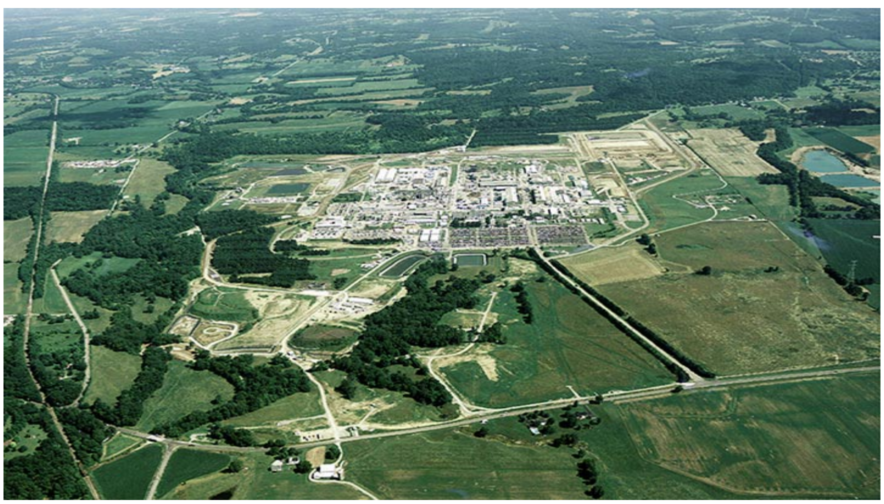

Figure 8. Recent aerial photograph of Fernald.

At the time of the support request, FEMP had recently completed a sitewide inventory and assessment of NISS materials that identified 622 NISS material items at Fernald, of which only 25 were active and still in use. Funding for disposal activities had not been included in the FEMP program baseline. However, the historical cost data associated with the disposal of similar items were included in the *Disposal Plan* and provided a basis for estimating these costs. As a first step, the remaining 597 items were subdivided, consistent with *NISS Materials*

e. NISSMG, "Fernald Sealed Source Disposal Plan," September 28, 2000.

Management Plan[f] methodology, into eight material streams for disposal purposes. The initial categorization was risk-based, focusing on the radiation and chemical characteristics. Materials were also categorized according to accountability criteria and common disposition path pathways (see the following table).

Fernald Sealed Source Disposal Plan

Sealed Source or Standard	Estimated Cost
Actinide Sources-1: 288 sealed sources and four different isotopes (U-238, Th-228, Th-230, and Th-232)	Waste profiling for NTS LLW disposal: \$50–\$100 per source range. Does not include shipping or site disposal.
Actinide Sources-2: 56 Am-241 sources	Disposal as TRU waste: \$100–\$150 per source range. Characterization for Waste Isolation Pilot Plant (WIPP) WAC: \$50,000 per drum.
Neutron Sources-1: Am/Be neutron sources in level gauges	Return to supplier: \$10,000 per source.
Orphan Sources-1: Am-241/Be neutron sources, Cesium-137 (Cs-137) gamma sources, Ra-226 sources	Return Am-241/Be source to supplier: \$10,000 per source. Characterize and prepare waste profile for disposal of Cs-137 sources as LLW: \$50-\$100 per source range. (Does not include shipping or site disposal.) Disposal as Normally Occurring Radioactive Material (NORM) at U.S. Ecology: \$1,500 per source range.
Accountable and Exempt Sources: 222 items with very small amounts of various isotopes	Waste profiling for NTS LLW disposal: \$50–\$100 per source range. Does not include shipping or site disposal.
Accountable and Exempt Sources-2: 51 items with some Ra-226	Disposal as NORM at U.S. Ecology: \$1,500 per source range. Does not include shipping or site disposal charges.

f. NISS Team, "Materials Management Plan for Nonactinide Isotopes and Sealed Sources (NISS)," Draft Rev. 0, December 4, 1998.

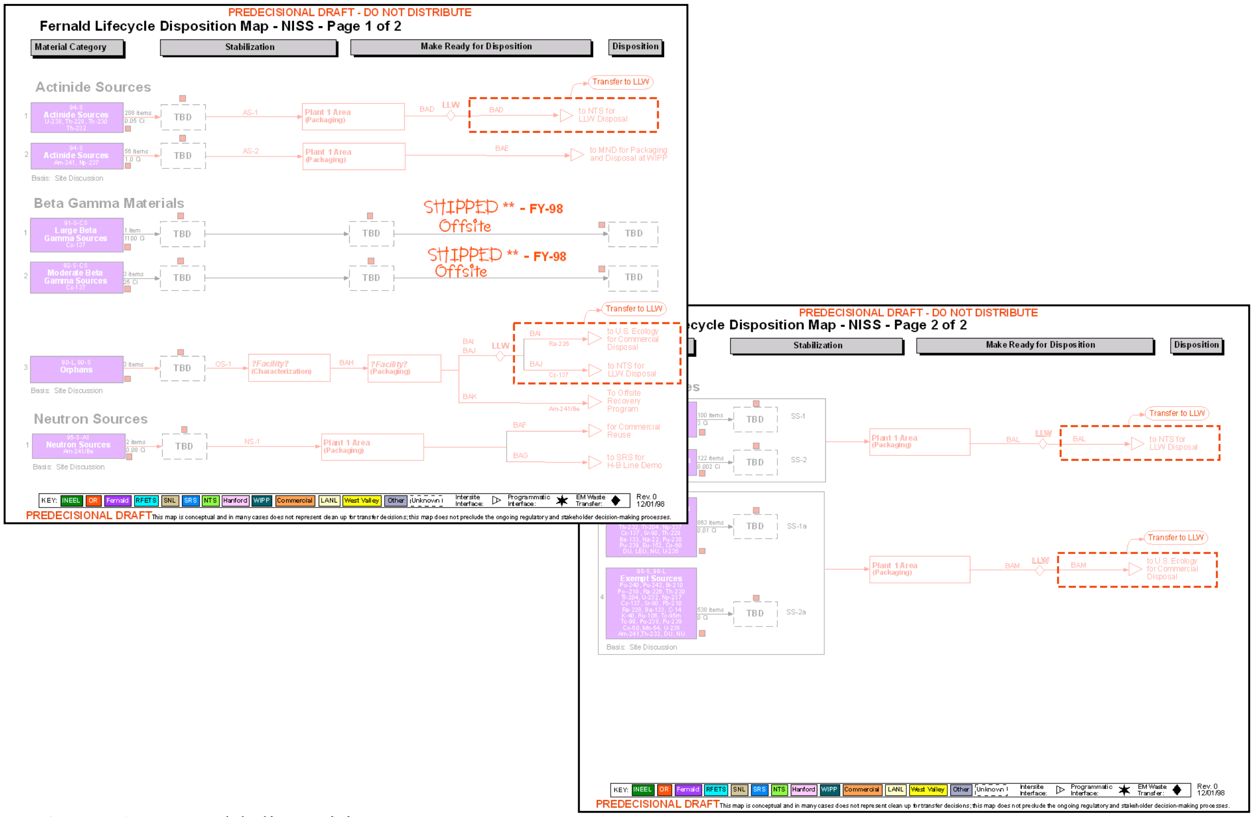

Figure 9. Fernald disposition maps.

At the joint Nuclear Materials Integration and Mixed/Low Level Waste Orphans workout in Albuquerque, New Mexico in April of 1999, two material streams of low enriched uranium (LEU) were identified as having disposition paths that were to be determined (TBD) by Fernald. On June 22, 1999, a joint team from NISSMG and the NMFA visited Fernald and found that these two orphan streams consisted of oversize pieces of LEU requiring size reduction before shipping and various LEU compounds requiring repackaging before shipping. Sizing and repackaging facilities and capabilities do not exist at Fernald. The materials are currently stored in 30-gallon drums, some are over packed in 50-gallon drums, and small amounts are stored in steel-banded wooden shipping containers.

The NISSMG agreed to assist Fernald in developing workable disposition opportunities for these materials. As a first step the NISSMG prepared conceptual disposition paths and the associated functional and operational requirements for the necessary sizing, sorting, and repackaging facility at Fernald. The disposition paths were submitted to Fernald and have been accepted as their site-planning baseline. In addition, NISSMG will work in concert with the Uranium/Thorium NMMG Team to further define the off-site processing possibilities, and the end-state requirements.

While disposal options are available for all Fernald NISS materials, the NISSMG is continuing to enhance and pursue more cost-effective means of disposal. Included in these activities are near term actions such as close coordination with the LLW disposal sites at NTS and Hanford to resolve any issues, including those associated with Ra-226 disposal. Resolving the Ra-226 issues could provide Fernald with a more cost effective disposal option for this material. The NISSMG will continue to support Fernald disposal activities by updating Fernald on improved disposal options throughout the DOE complex.

690 Net lbs. 138 U lbs. 782.4 U235 g	H068: 980: M: 076: A888:	Mark I A12 N-Reactor Production Last processed through ZIRNLO 1.25 wt% Enriched, Alloy 601 ZIRNLO ends for recovery Batch number	Almost full of fuel elements of various sizes that appeared to range from ~4" to 8" in length, ~2.0" od, ~1/4-1/2" wall thickness. Appeared to be bare, not clad, annular cylinders. Some moisture. (Possibly ship in 1A2 at <350g U235 quantities.)

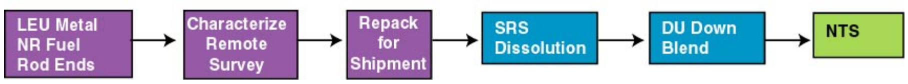

Figure 10. Orphan LEU metal disposition path.

351 Net lbs. 341.5 U lbs. 1,466.9 U235 g	H069: 920: H: 104: 0285:	Mark I N09 N-Reactor Production Plant 9 Casting 0.947 wt% Enriched, Alloy 601 Metal spills and extrusion ends September 1985 production	Only one piece in drum Appeared to be a top crop, which would be 10.855 diameter for H069 and ~3" thick. Dry. (Possibly size reduce and ship in 1A2 at <350 g U235 quantities).

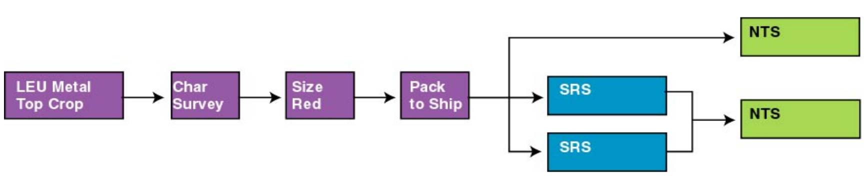

Figure 11. Orphan LEU metal top crop disposition path.

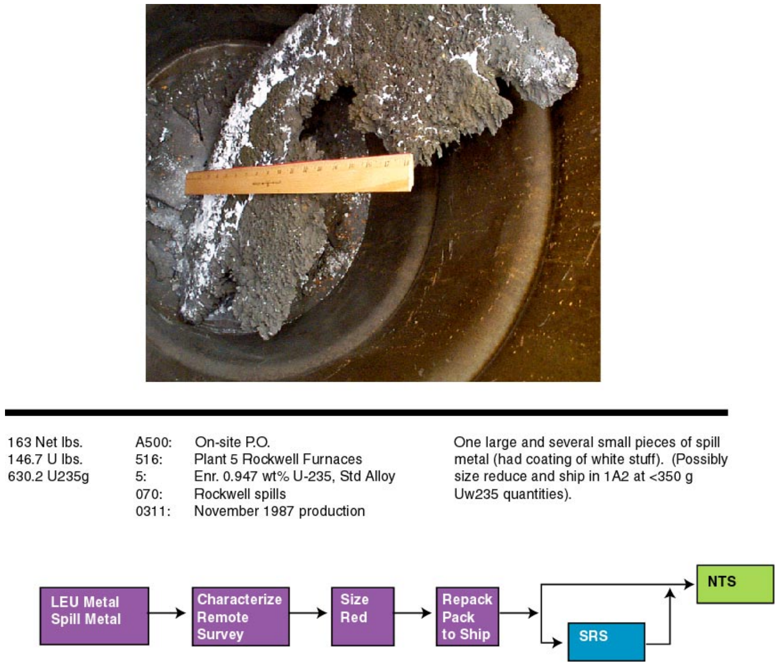

Figure 12. Orphan LEU metal spill metal disposition path.

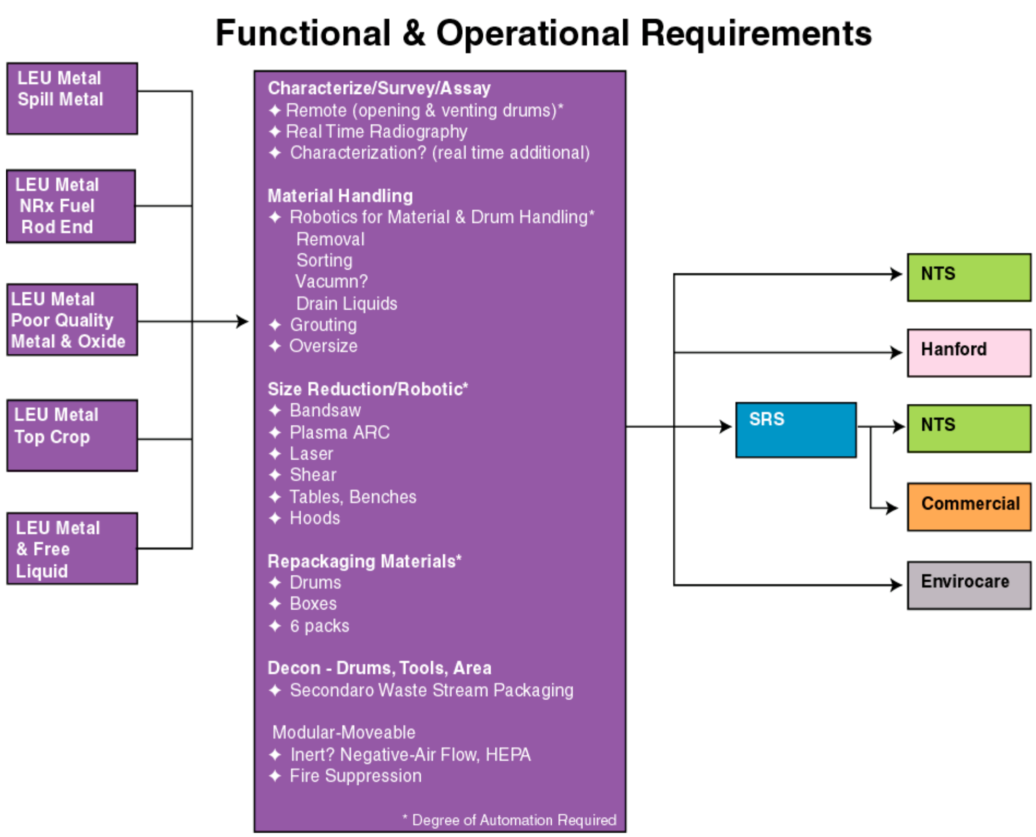

Figure 13. Functional and operational requirements.

5.3 Rocky Flats

At the request of Rocky Flats Environmental Technology Site (RFETS) staff, the NISSMG provided assistance in developing disposal options for RFETS orphan small sources contained in two barrels in Building 126 that had no disposition path.

Figure 14. Rocky Flats.

The NISSMG staff determined the problem warranted a novel approach. They prepared a plan to individually characterize a fraction of the orphaned sources and use these to validate the "mass or bulk characterization" of the remaining sources. Once the bulk characterization results were validated, the orphan sources in Building 126 could then be disposed of as a single barrel of LLW.

The NISSMG database for RFETS has over 3,880 records, of which some 3,250 are small or exempt (per DOE Notice N-441.1) sources destined for disposal as LLW. Additionally, there are over 3,600 other small or exempt sources currently stored in containers awaiting disposal. These sources have little or no characterization data available to support disposal plans. These sources were manufactured at RFETS as instrument check sources and can be divided into three categories: (1) check sources for Ludlum 12-1A instruments, (2) glove box alpha metal check sources, and (3) miscellaneous discs and wafers. Most of these sources are Pu-239, however some are Am-241 or other isotope sources.

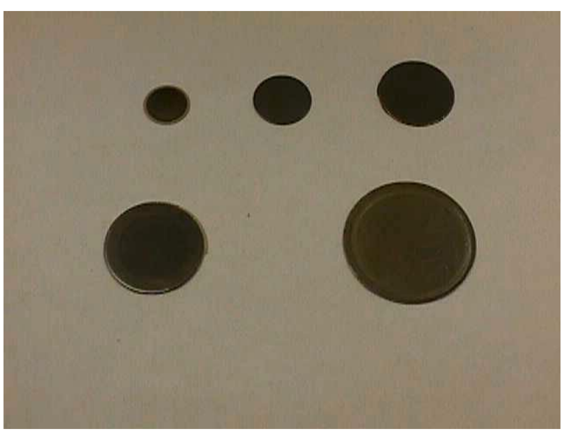

Figure 15. 0.5–2.5 inch disc/wafer sources.

RFETS measured the activity of 2,100 of these sources as part of their Radiation Control Technician (RCT) training program. NISSMG used the data obtained from this effort to define the baseline activity levels for the remaining 1,500 sources. Then, using this data as a baseline and model, a nondestructive assay of the shipping containers could be performed to produce the required waste profile meeting the Hanford LLW disposal site WAC.

Based on the latest information provided by RFETS, NISSMG believes that a formal waste profile can be prepared and the sources can be disposed of as equivalent to NRC Class Three LLW. The sources can be packaged and consolidated into a 30 or 55 gallon drum with the voids filled. A filler will be sufficient; grout is not necessary as the isotopic inventory is well DOT Category 1 or 3 limits. The drum can then be shipped to Hanford for disposal at the LLW disposal site.

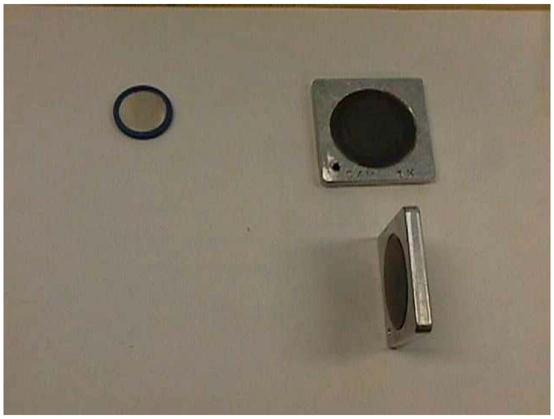

Figure 16. 1–1.5 inch round sources attached to 2 inch square aluminum housings.

On May 10, 2000, the DOE Richland Operations Office agreed with the NISSMG approach to bulk characterize the RFETS sources as LLW. In recent NISSMG discussions, NTS stated they are now willing to consider this NISSMG methodology.

One of the significant benefits of this option is the cost savings. Standard disposal costs are about $500 per source to characterize, profile, package, and ship to a disposal site. The original estimated cost for this activity was $1,500,000. However, using the NISSMG proposed bulk characterization method to characterize, profile, package, and ship as a single drum of radioactive material for disposition, the estimated cost for this service is $25,000, resulting in a net savings to DOE of $1,475,000. These savings can be multiplied as this approach is used in similar situations at other sites in the future.

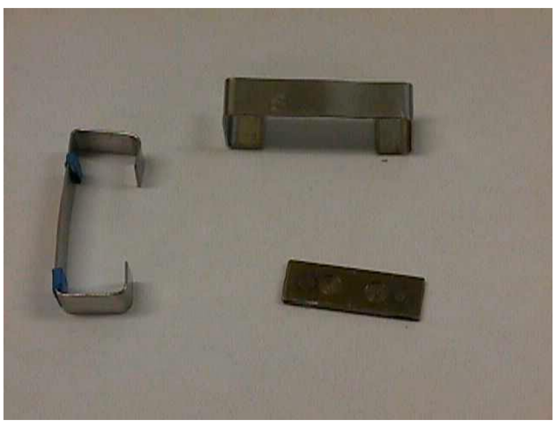

Figure 17. 1–0.75 inch strip sources, some attached to strap metal brackets.

Small and exempt sources shipment is proposed to occur in calendar year 2001. Estimated cost savings are $1,475,000.

6. ACTIVE SITE AND PROJECT SUPPORT

In addition to the support that the NISSMG offers DOE's EM closure sites, the NISSMG has provided support this year in dispositioning NISS materials at the active sites and projects with considerable cost savings in many instances.

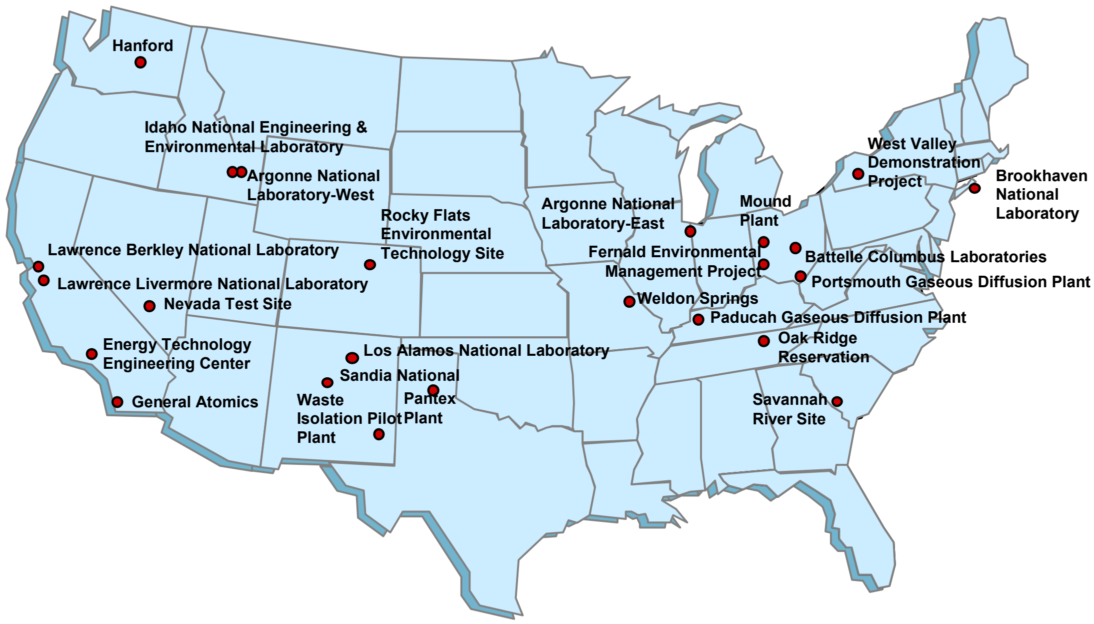

Figure 18. DOE EM active sites and projects.

6.1 Hanford

At the Pacific Northwest National Laboratory (PNNL) located on DOE's Hanford Reservation near Richland, Washington, the NISSMG has been instrumental in getting Californium Reactor HEU shipped to the SRS. The NISSMG staff who supported the Mound Plant Californium reactor shipment facilitated the PNNL agreement and shipment.

6.2 Battelle Columbus

At DOE's Battelle Columbus Laboratories, in Ohio, the NISSMG orchestrated a reuse option for Pu-238 to go to LANL for use in the NE-50 space program and for Pu-239 to go to SRS. The NISSMG coordinated the joint shipment of the Battelle Pu-239 and the Mound Plant Pu-239 shipment to SRS on October 2, 2000. The Pu-238 shipment to LANL is waiting approval of a shipping container.

6.3 Oak Ridge

The ETTP at the OR site has the second largest quantity of separated Sr-90 in the DOE complex. This material is contained in RTGs. These RTGs were manufactured at OR for DOD missions but were never deployed and contain about 1,500,000 Ci of Sr-90 material. The NISSMG staff have been evaluating disposal of these materials as mixed hazardous and low level radioactive waste (MLLW) at Hanford and cannot find a technical reason that would prevent using this disposal option for all but one of the RTGs. However, one of the OR RTGs does contain about 1,000,000 Ci of material and the NISSMG is considering reuse options in lieu of direct disposal. Additionally, the certificate of compliance (C of C) for the shipping containers has expired, complicating the disposal process.

Figure 19. RTG in shipping container.

6.4 Sandia National Laboratories

Sandia National Laboratories owns an excess SNAP-21 (Systems for Nuclear Auxiliary Power) RTG, containing Sr-90 that has decayed since its arrival to less than 15,000 Ci. In conjunction with the NISSMG activities at ORNL, conceptual discussions with DOE Hanford LLW disposal site are underway. In reviewing the Hanford LLW WAC, NISSMG can find no technical reason why this item could not be entombed in the Hanford MLLW trench when the National Environmental Policy Act activities are complete in calendar year 2001. However, there will probably be Hanford site stakeholder issues that will need resolution. Chief among these is "site equity," which means that for this action to be completed, existing nuclear material will need to leave the Hanford site. The Department of the Navy recently renewed their SNAP-21 C of C for this container, with a new expiration date of November 2005. NISSMG recommends that Sandia continue to ensure the C of C is maintained for their RTG.

7. STUDIES

In the past year, the NISSMG has be instrumental in the preparation of a number of different studies about how best to disposition certain NISS materials. Some of these studies will be continuing in fiscal year 2001.

7.1 Beryllium Reflector Disposal

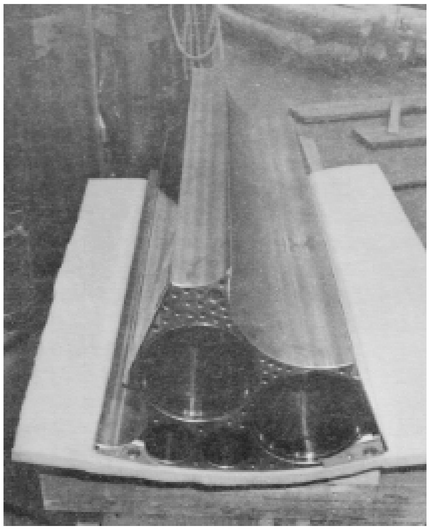

Figure 20. Machined reflector block before assembly.

The Advanced Test Reactor (ATR) and the High Flux Isotope Reactor (HFIR) at the Idaho National Engineering and Environmental Laboratory (INEEL) and ORNL, respectively, use beryllium reflectors as an internal framework structure due to beryllium's favorable physical properties. Disposition of these reflectors is complicated due to the fact that normal operation of these reactors produces tritium in the beryllium materials. These reflectors, which are currently stored in spent fuel pools or dry storage at their respective sites, represent orphan materials with no viable disposition pathway. In addition, since ATR and HFIR are operating reactors, the DOE Order 435.1 (and associated Manual M435.1) requires radioactive waste generators to define a life-cycle disposition path for the legacy and newly generated beryllium with minimal subsequent processing to establish disposal pathways.

The NISSMG is working with the INEEL and ORNL to establish viable disposal alternatives. The proposed suite of alternates also takes the additional step of defining the complete disposition pathway for the beryllium, not just focusing on tritium extraction.

The evaluation of disposal alternatives is in process and will be completed early in calendar year 2001, with a report to be issued in June.

7.2 Cesium and Strontium Items

Figure 21. ATR reactor core.

The NMI Project identified over 9,000 Cs and/or Sr items, containing over 71 million curies, currently in DOE's possession. Although current disposition plans address a little over 70 million curies of the activity, they only address about 2,000 of the individual items. The remaining 7,000 items do not have clear disposition alternatives and therefore may impact facility or site closure plans or costs, or could even present risks to workers or the environment if not stored and dispositioned properly. A trade study of disposition alternatives was completed, including supporting cost and environment, safety and health risk analyses in fiscal year 2000. A workshop is planned for January 17th and 18th, 2001 to evaluate disposition alternatives and to identify a recommended path forward for senior management in the February 2001 timeframe.

7.3 EM-21 TBD Resolution

The EM-level Nuclear Materials Stewardship Program has, in conjunction with site inputs, developed and maintained a set of "nuclear material baseline disposition maps" that depict all nuclear materials that are EM-owned, currently stored at EM facilities, or projected to come to EM by 2015.[g] These maps were initially developed in FY 1998 via site visits, contacts with knowledgeable personnel, and consultation with other resources, and were updated with site inputs in the1999 and 2000 Integrated Planning, Accountability, and Budgeting System data calls. These maps show, for each materials stream, the ultimate disposition destination (for reuse or disposal) and any treatment and storage steps to be undertaken prior to dispositioning.

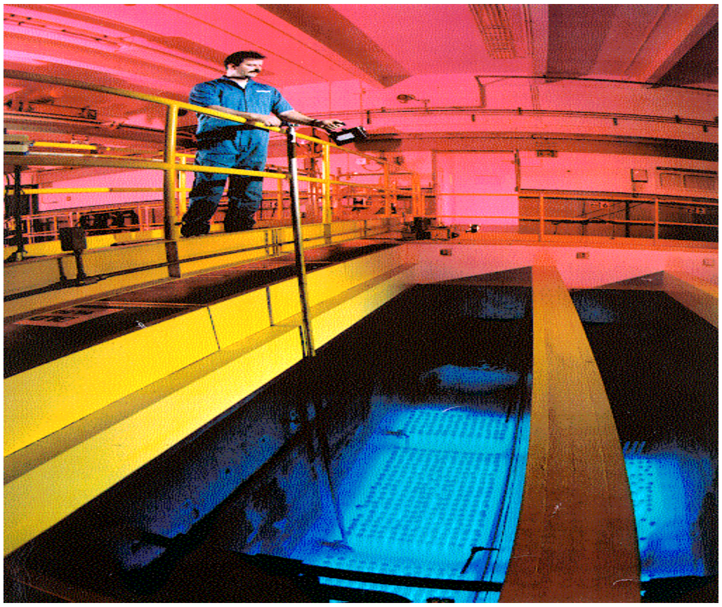

Figure 22. Waste Encapsulation and Storage Facility (WESF) storage pool at Hanford.

Process steps that are unknown or indeterminate, for whatever reason, are labeled as "TBD" (to be determined). Other process steps in site disposition plans that can be identified often involve some uncertainty (or programmatic risk). The degree of programmatic risk of various treatment, storage, programmatic (and/or site) transfer, and dispositioning steps was assessed in the past by use of scoring criteria and technical judgment of evaluators to label such steps as "Red," "Yellow," or "Green," (referring to high programmatic risk, medium programmatic risk, or low programmatic risk, respectively). Any materials stream with one or more TBDs in its baseline path is labeled a "TBD stream," and the non-TBD materials streams are likewise categorized as Red, Yellow, or Green, depending on the step in the baseline disposition pathway with maximum programmatic risk.

The goal of the EM-level nuclear materials stewardship program is to support the EM *Paths to Closure* Plan[h] by enabling the timely disposition of surplus nuclear materials from EM facilities' and sites' inventories. In support of this overall program goal, the

g. These maps also show nuclear materials with undetermined dispositions and for which future EM management is possible.
h. U.S. Department of Energy, Office of Environmental Management, *Accelerating Cleanup Paths to Closure*, DOE/EM-3062, June 1998.

"Resolve Disposition Paths for TBDs for EM Nuclear Materials" project has the following objectives:

1. Identify all major categories of nuclear materials that must be managed and dispositioned by EM.
2. Identify all necessary EM disposition planning that is needed for surplus nuclear materials coming into EM by 2015, and establish disposition baselines where possible.
3. Identify integration opportunities (i.e., issues that are appropriate to examine in an integrated, complexwide manner, as with trade studies or working group assessments).
4. Develop the technical information needed to resolve all issues that prevent mature site disposition plans from being formulated and executed.

The first two objectives can be accomplished by developing a complete, comprehensive set of disposition maps and supporting data fields. For each site's surplus nuclear materials inventory, the approach is to develop a technically inspired list of surplus nuclear materials categories (without necessarily being comprehensive in identifying all constituent material items within each category) and establishing at least a generic baseline disposition pathway (if not a site-specific one) for each of these material categories.[i] The third objective is presently accomplished using available information known to program personnel of similar situations at multiple DOE sites, but could be accomplished in the future by analyzing data (in the maps and in other available data sources) of sufficient quality. The fourth objective is accomplished by assessing the TBD, Red, and Yellow materials streams (and all pertinent information associated with these disposition plans), in order to identify and analyze the issues that prevent sites from formulating and executing mature disposition plans.

The "TBD Project" will partially accomplish these objectives via the FY 2001 activities described in the *TBD Project Management Plan*.[j] Further efforts beyond those described in the plan will be conducted either by a continuation of TBD Project team activities, or by actions of any resource teams such as NMMGs.

i. Examples of such generic maps are contained in the *Pu-239 Material Management Plan*.
j. EM-level Nuclear Materials Stewardship Program, *Project Management Plan for 'Resolve TBD Disposition Paths for EM Nuclear Materials'*, October 2000.

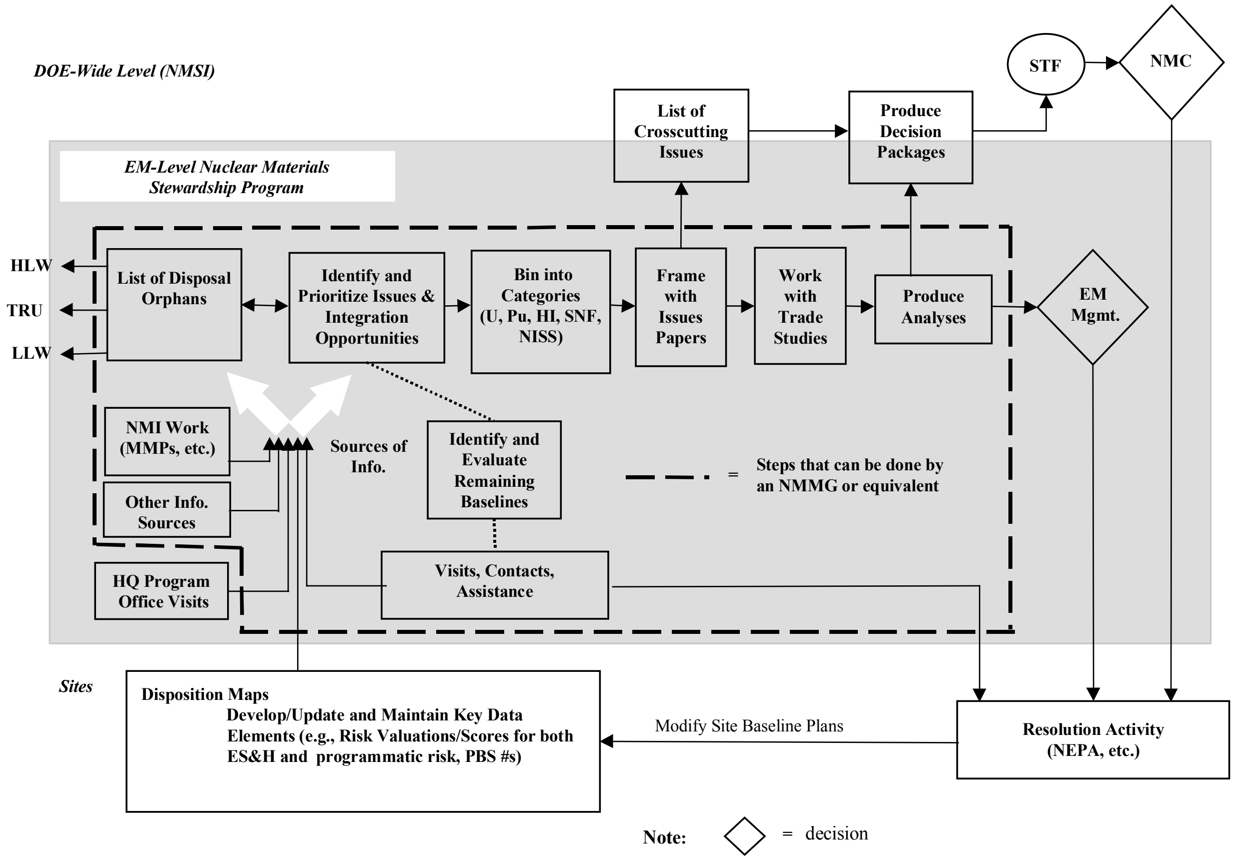

Figure 23. Process to resolve TBDs in plans shown in EM nuclear material baseline disposition maps.

8. LESSONS LEARNED IN HANDLING ORPHAN NISS MATERIALS

In the support that the NISSMG has provided sites over the last year, there are a number of lessons learned that will benefit future efforts in dispositioning NISS materials.

Lesson 1: NISS materials will impact the critical closure path for sites and facilities.

Closure sites logically focus on what they see as their big problems, such as large volume waste streams and environmental restoration problems, but frequently neglect NISS materials until it is too late. They underestimate the difficulty in disposing of the large variety of materials in most NISS inventories. Lead-time to negotiate receiver sites and make transportation arrangements for NISS materials can be significant, and delays can lead to lost opportunities as the DOE infrastructure diminishes.

Lesson 2: Expect growth in NISS material inventories from initial assessments.

Many NISS materials are not accountable and most sites do not maintain centralized records for these materials. In addition, sites will identify new materials as facilities are closed and materials are consolidated. For example, more than a third of the Mound Plant material streams were identified after the initial site assessment. Consequently, sites will need to maintain flexibility to deal with the unexpected until they have a high confidence that all NISS materials have been identified.

Lesson 3: Always investigate reuse first when dealing with orphan materials.

NISSMG activities supporting the deinventory of Mound have provided a set of lessons learned for future interactions with closure sites and facilities.

Closure sites have finite budgets and necessarily strive to minimize cost and accelerate schedule when disposing of materials. Most assume that disposing of the NISS materials as waste will satisfy these objectives, but reuse is often a better option and implements DOE's Pollution Prevention principles. For example, more than half of the Mound Plant material streams could be reused. For Mound Plant irradiated thorium materials, reuse resulted in substantial cost and schedule savings.

Lesson 4: Closure sites and small sites are often extremely limited in their nuclear material operations.

In an attempt to reduce costs, many sites have rushed to close facilities; this, coupled with the lost knowledge due to retirement and cutbacks of large numbers of experienced workers, many sites do not have the resources at hand to deal with the NISS materials. For example, all nuclear material operations at the Mound Plant had to be completed without a glove box.

Lesson 5: Leverage resources from across the complex and private industry.

Communication between DOE sites has always been somewhat hit and miss; thus, closure and small sites are not often aware of facilities and capabilities that exist at other DOE sites and in private industry. Ineffective use of these outside resources can result in inefficient solutions to site problems and delays in closure. Resources can also be wasted either by developing solutions that already exist or by not sharing developed solutions.

Figure 24. NISSMG team.

Lesson 6: Challenge all assumptions regarding orphan materials

Many orphan NISS materials have existed for some time and preconceived notions exist about what cannot be done with them. Such notions must be reexamined. All options must be examined carefully and no option discarded prematurely. Difficult orphan materials problems require creativity to resolve. Life-cycle analysis is the key to identifying the preferred option.

Lesson 7: Seek optimal solutions for the lifecycle of the material

Understandably, closure sites are focused on getting NISS material off their sites. However, the quickest and cheapest way off the site may not be the best solution in terms of life-cycle cost, programmatic risk, waste minimization, or material reuse. A central management organization chartered to perform this function is the only effective way to address this issue. The NISSMG is uniquely suited to perform this function for DOE.

9. CONCLUSIONS OR PATH FORWARD

The fiscal year 2000 operations of the NISSMG validate the concept of management centers: (a) focused around a specific scope of materials, and (b) serving as a complexwide resource to facilitate the effective management of these materials. With modest resources, the NISSMG has demonstrated a substantial benefit though its direct support of closure sites and more general studies of complexwide issues. The successful deinventory of the Mound Plant and development of baseline NISS materials management plans for Fernald and Rocky Flats, are significant contributions to the Department's *Paths to Closure* strategy. Ongoing studies of issues such as cesium and strontium items, beryllium reflector disposal, and others, promise to give even greater returns in addressing cross-cutting issues for the EM nuclear materials complex.

A number of the activities reported here are the culmination of multiyear efforts. These early NISSMG activities have focused on closure site support, which will continue in FY 2001. Additionally, NISSMG will complete trade studies for the following:

Cesium/Strontium—NISSMG will evaluate disposition alternatives and identify a recommended path forward in February 2001 timeframe.

Neutron Sources—The Neutron Sources Trade Study has looked at potential disposition options and issues, and is anticipating additional opportunities for coordination and collaboration with the OSRP.

Beryllium Reflectors—Evaluation of alternatives continues and will be completed early in calendar year 2001.

NISSMG will also initiate and complete the following new trade studies addressing issues for NISS materials across the complex:

Liquid Technical Materials and Standards—Liquid technical materials and standards pose troublesome issues at closure sites and other DOE facilities. This trade study will work with the closure sites and other facilities in the complex to analyze the inventories and define disposition options for these materials.

Special Performance Assessment Required Materials—Large numbers of excess nuclear material items exist in the DOE complex, but have no viable disposition path. The purpose of this study is to provide a preliminary assessment document defines the scope of the problem.

Strategies:

Assist closure sites in the implementation of disposal and reuse options.

Assist sites in securing funding to support disposal activities.

Participate in complex wide evaluations of disposal/reuse options.

Develop site equity positions that will facilitate utilization of existing assets to complex wide material needs.

Initiate and **assist** sites in obtaining assistance from other DOE programs.

Other future NISSMG activities will include:

- Establishing a virtual source bank
- Evaluating disposal site use/access requirements training
- Establishing a Web-based program with examples of accepted waste profiles for specific isotopes and material forms.

The concept of the NISSMG operating as a virtual organization, with a small core team of permanent members, and a large resource pool from across the DOE complex and private industry has proven effective. Core team members from the INEEL and SNL have drawn on the expertise of staff from Argonne National Laboratory, Hanford, INEEL, ORNL, LANL, NTS, SNL, and

SRS, as well as private industry contacts, to deliver its FY 2000 results. Cooperative efforts with DOE staff at operations and field offices have assisted in obtaining results. The lessons learned and experience developed in closure site interactions have been captured and documented so that they can be shared with other sites experiencing similar problems. The successes of the NISSMG operations in FY 2000 have already generated a number of additional requests for support in FY 2001.

Figure 25. Nuclear material (Th and U-233) leaving the Mound Plant.

The Nonactinide Isotope and Sealed Source Management Group (NISSMG) provides experienced technical personnel who implement innovative solutions using complexwide resources for site specific issues.